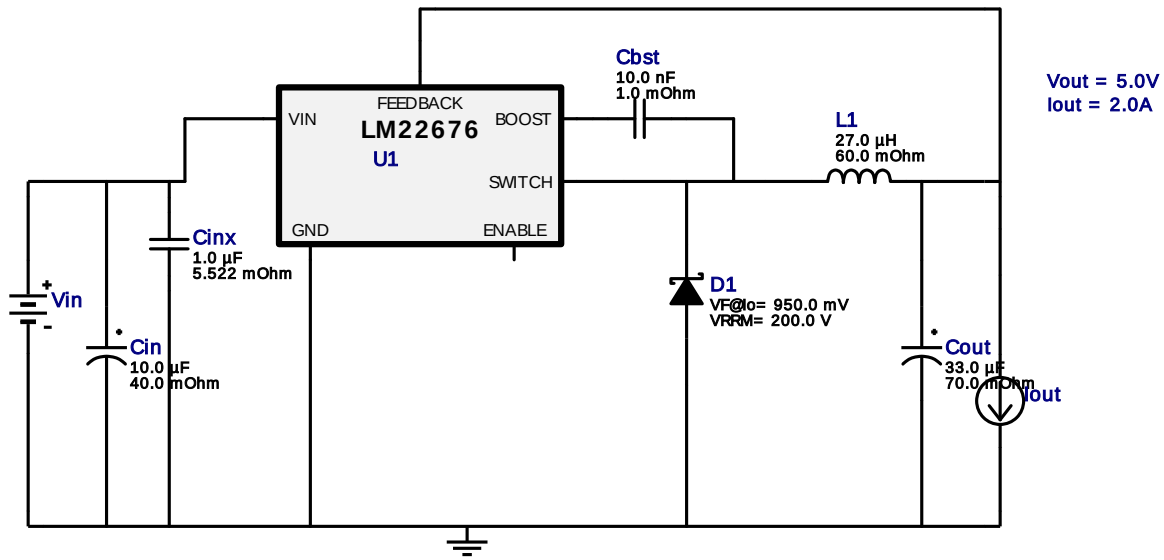
WEBENCH® Design Report

VinMin = 12.0V
VinMax = 30.0V
Vout = 5.0V
Iout = 2.0A

Device = LM22676MRE-5.0/NOPB
Topology = Buck
Created = 2019-02-10 16:30:34.170
BOM Cost = $3.35
BOM Count = 7
Total Pd = 2.63W

Design : 1 LM22676MRE-5.0/NOPB
LM22676MRE-5.0/NOPB 12V-30V to 5.00V @ 2A



Electrical BOM

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbst	MuRata	GRM216R71H103KA01D Series= X7R	Cap= 10.0 nF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
Cin	Panasonic	50SVPF10M Series= SVPF	Cap= 10.0 uF ESR= 40.0 mOhm VDC= 50.0 V IRMS= 2.5 A	1	$0.38	CAPSMT_62_F61 74 mm²
Cinx	TDK	C1608X5R1H105K080AB Series= X5R	Cap= 1.0 uF ESR= 5.522 mOhm VDC= 50.0 V IRMS= 2.2162 A	1	$0.04	0603 5 mm²
Cout	Panasonic	10TPB33M Series= TPB	Cap= 33.0 uF ESR= 70.0 mOhm VDC= 10.0 V IRMS= 1.1 A	1	$0.31	3528-21 17 mm²
D1	SMC Diode Solutions	SBRD10200TR	VF@Io= 950.0 mV VRRM= 200.0 V	1	$0.12	DPAK 102 mm²
L1	Bourns	SDR1307-270ML	L= 27.0 µH DCR= 60.0 mOhm	1	$0.42	SDR1307 226 mm²

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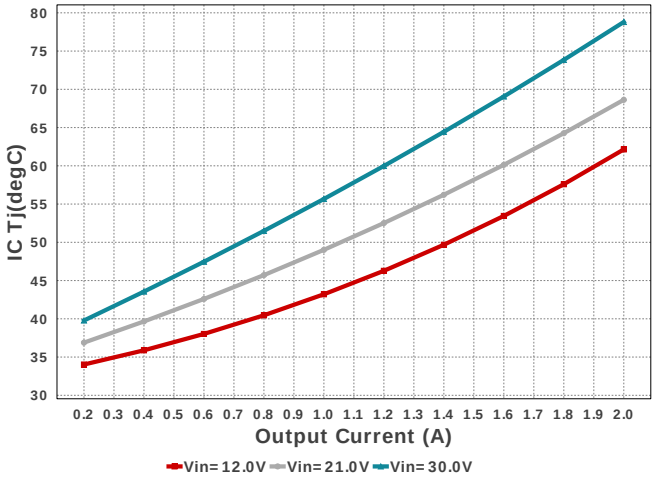
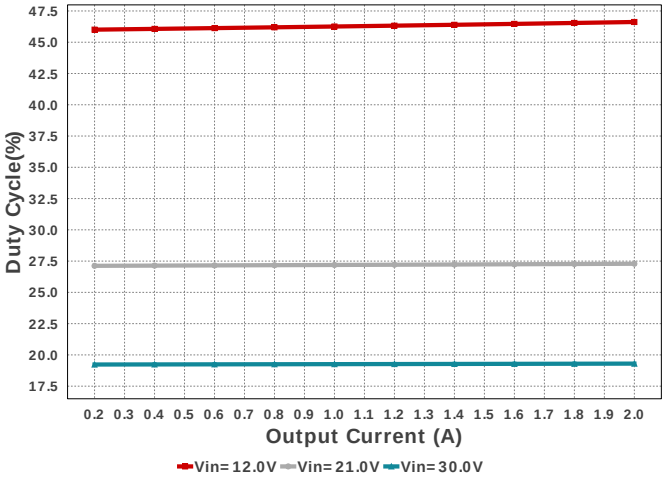
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
U1	Texas Instruments	LM22676MRE-5.0/NOPB	Switcher	1	$2.07	MRA08B 56 mm²

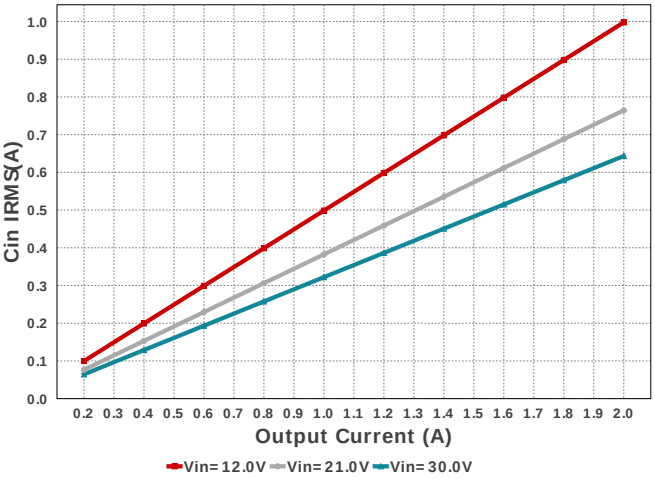
IC Tj



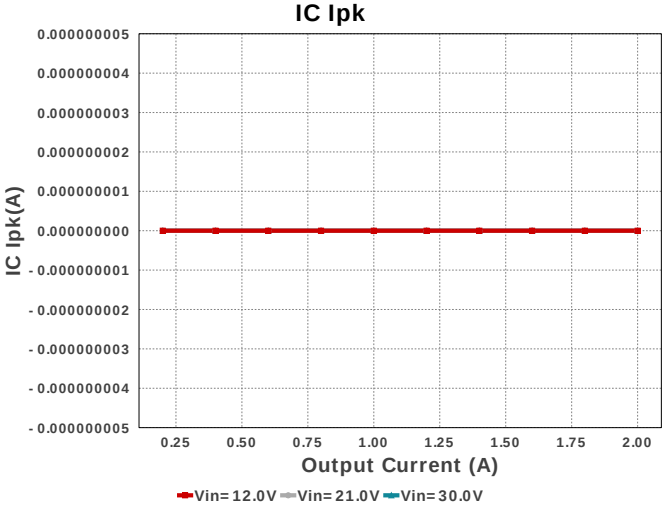
Duty Cycle



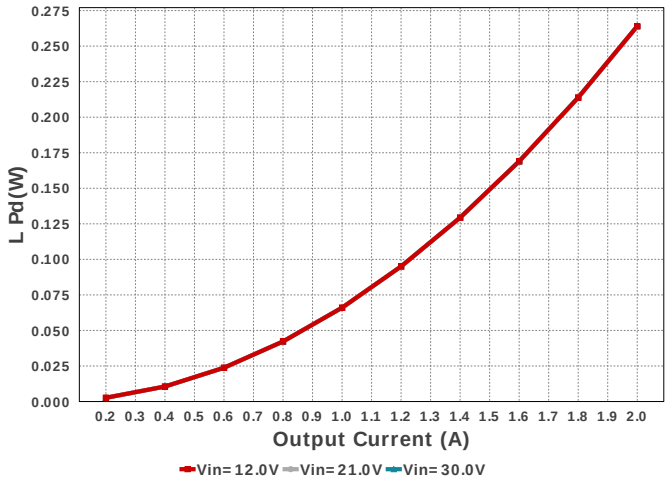
Cin IRMS



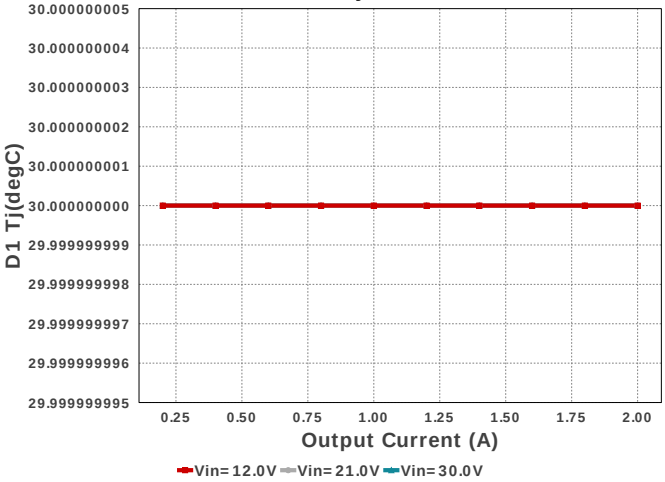
IC Ipk



L Pd



D1 Tj



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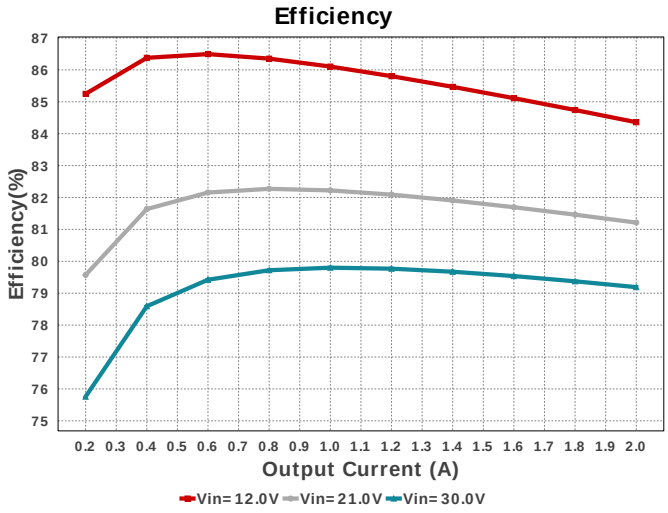

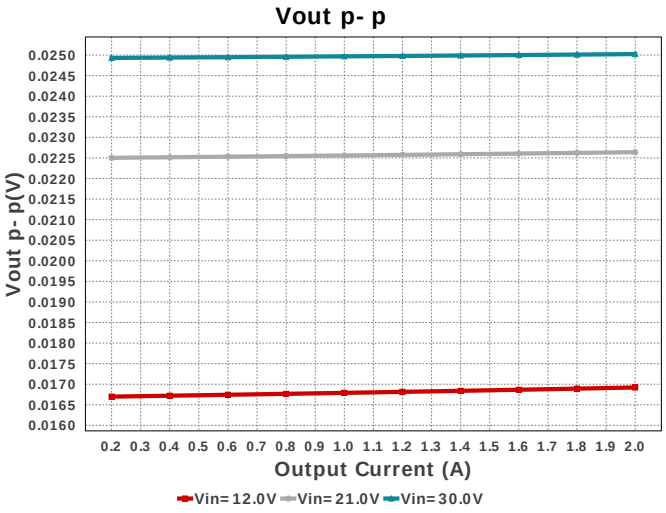

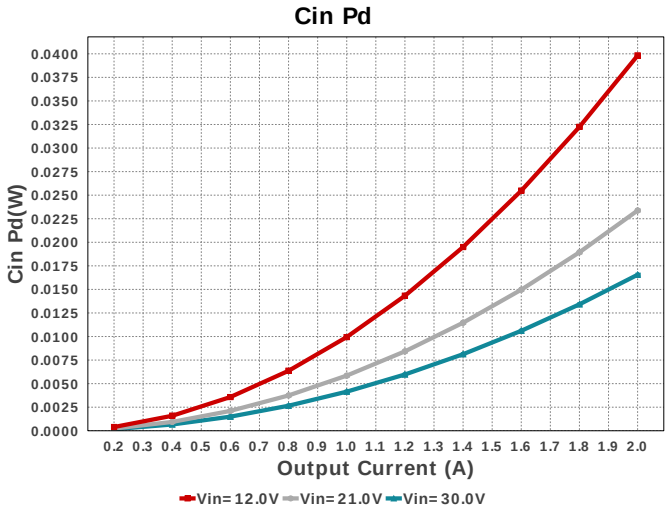

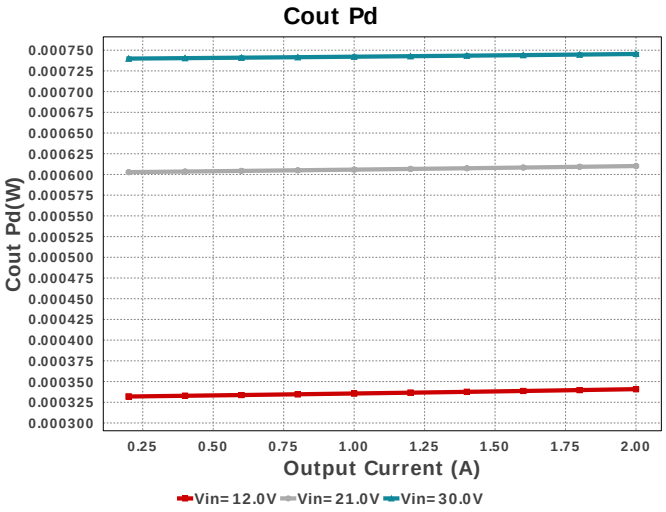

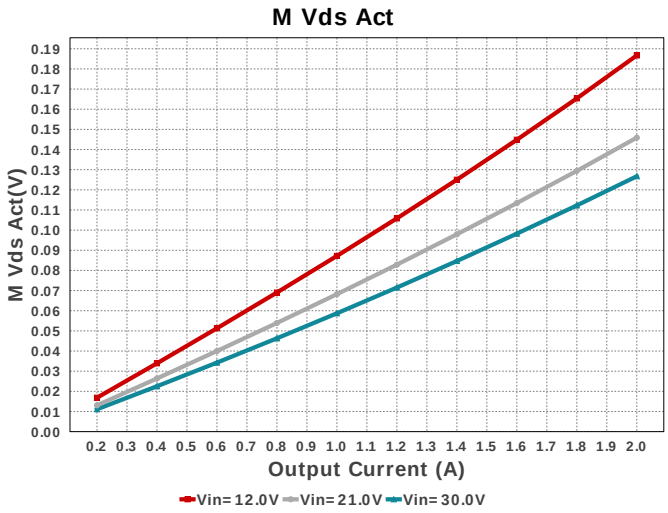

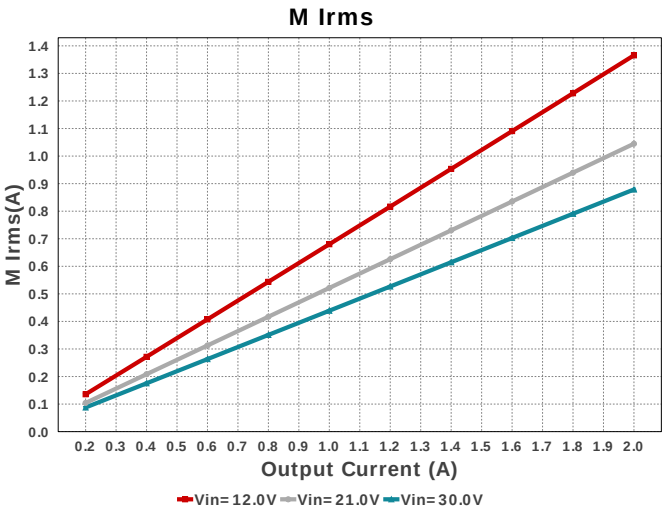

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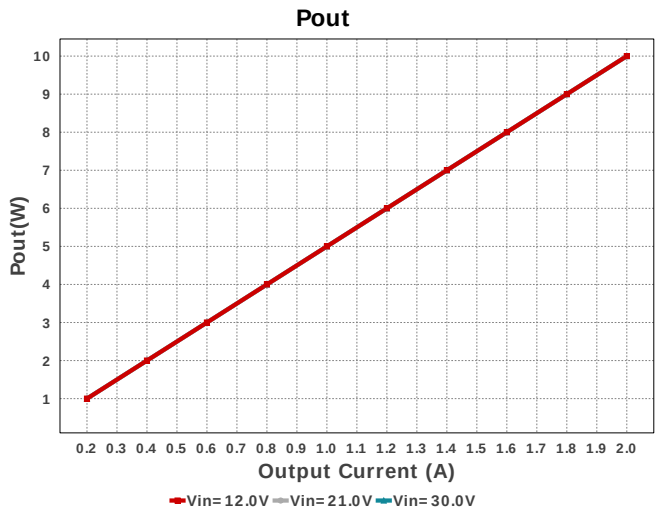

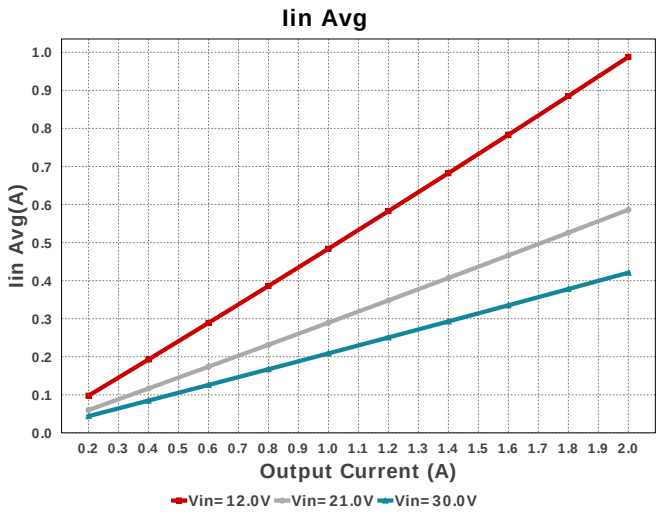

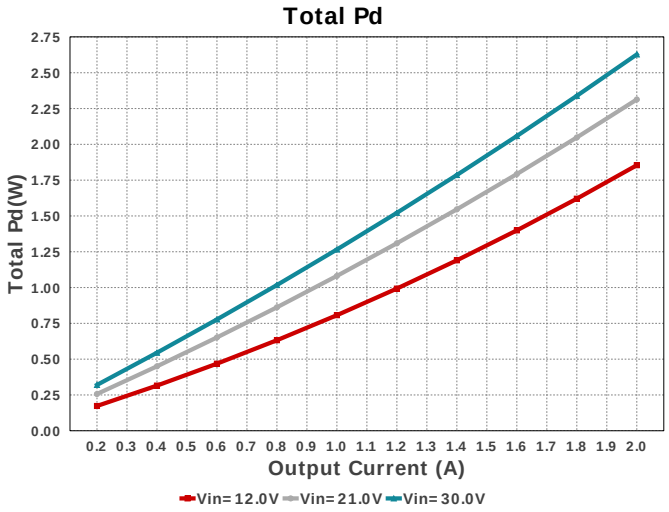

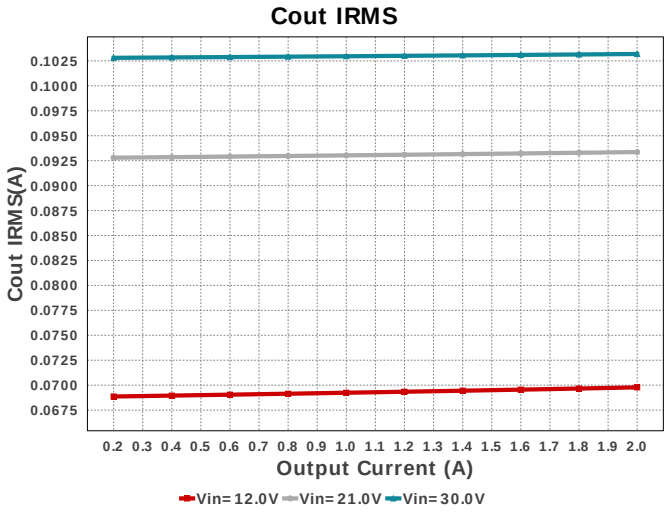

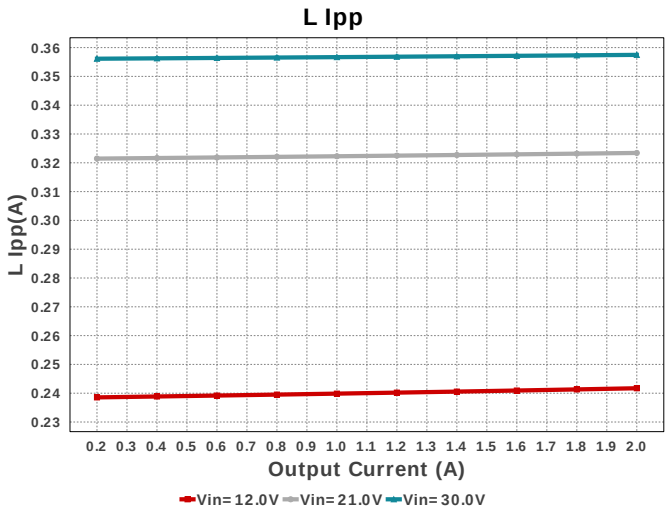

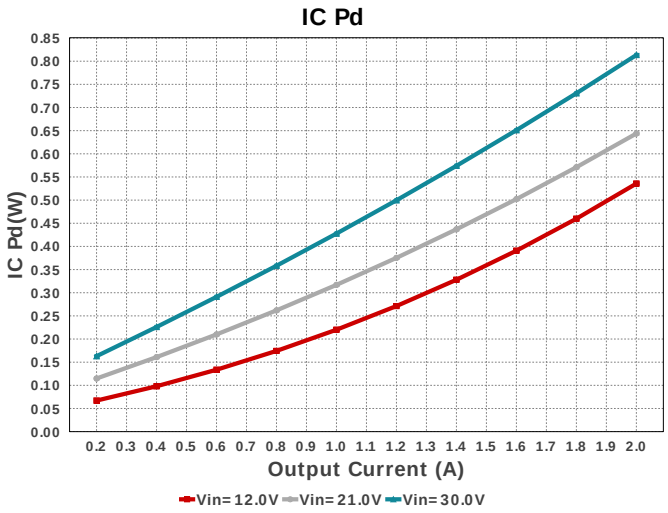

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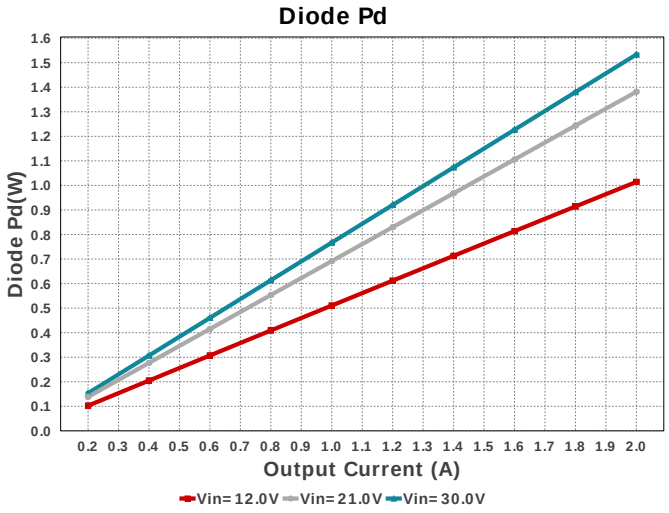

Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	643.327 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	16.555 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	103.194 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	745.43 µW	Capacitor	Output capacitor power dissipation
5.	D1 Tj	30.0 degC	Diode	D1 junction temperature
6.	Diode Pd	1.533 W	Diode	Diode power dissipation
7.	IC Ipk	0.0 A	IC	Peak switch current in IC
8.	IC Pd	813.35 mW	IC	IC power dissipation
9.	IC Tj	78.801 degC	IC	IC junction temperature
10.	IC Tolerance	75.0 mV	IC	IC Feedback Tolerance
11.	ICThetaJA	60.0 degC/W	IC	IC junction-to-ambient thermal resistance
12.	Iin Avg	420.93 mA	IC	Average input current
13.	L Ipp	357.47 mA	Inductor	Peak-to-peak inductor ripple current
14.	L Pd	264.0 mW	Inductor	Inductor power dissipation
15.	M Irms	878.717 mA	Mosfet	MOSFET RMS ripple current
16.	M Vds Act	126.72 mV	Mosfet	Voltage drop across the MosFET
17.	Cin Pd	16.555 mW	Power	Input capacitor power dissipation
18.	Cout Pd	745.43 µW	Power	Output capacitor power dissipation
19.	Diode Pd	1.533 W	Power	Diode power dissipation
20.	IC Pd	813.35 mW	Power	IC power dissipation
21.	L Pd	264.0 mW	Power	Inductor power dissipation
22.	Total Pd	2.628 W	Power	Total Power Dissipation
23.	BOM Count	7	System Information	Total Design BOM count
24.	Cross Freq	56.177 kHz	System Information	Bode plot crossover frequency
25.	Duty Cycle	19.304 %	System Information	Duty cycle
26.	Efficiency	79.19 %	System Information	Steady state efficiency
27.	FootPrint	486.0 mm^2	System Information	Total Foot Print Area of BOM components
28.	Frequency	500.0 kHz	System Information	Switching frequency
29.	Iout	2.0 A	System Information	Iout operating point
30.	Mode	CCM	System Information	Conduction Mode
31.	Phase Marg	82.548 deg	System Information	Bode Plot Phase Margin
32.	Pout	10.0 W	System Information	Total output power
33.	Total BOM	$3.35	System Information	Total BOM Cost
34.	Vin	30.0 V	System Information	Vin operating point
35.	Vout	5.0 V	System Information	Operational Output Voltage
36.	Vout Tolerance	1.5 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
37.	Vout p-p	25.023 mV	System Information	Peak-to-peak output ripple voltage

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Design Inputs

Name	Value	Description
Iout	2.0	Maximum Output Current
VinMax	30.0	Maximum input voltage
VinMin	12.0	Minimum input voltage
Vout	5.0	Output Voltage
base_pn	LM22676	Base Product Number
source	DC	Input Source Type
Ta	30.0	Ambient temperature

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WEBENCH® Assembly

Component Testing

Some published data on components in datasheets such as Capacitor ESR and Inductor DC resistance is based on conservative values that will guarantee that the components always exceed the specification. For design purposes it is usually better to work with typical values. Since this data is not always available it is a good practice to measure the Capacitance and ESR values of Cin and Cout, and the inductance and DC resistance of L1 before assembly of the board. Any large discrepancies in values should be electrically simulated in WEBENCH to check for instabilities and thermally simulated in WebTHERM to make sure critical temperatures are not exceeded.

Soldering Component to Board

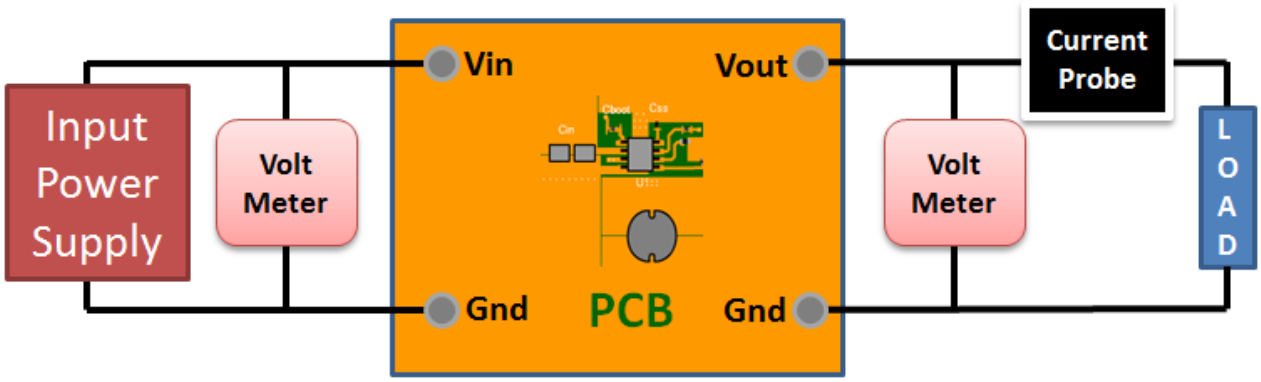
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. To solder the tab town to the board place the iron down on the board while resting against the tab, heating both surfaces simultaneously. Apply light pressure to the top of the plastic case until the solder flows around the part and the part is flush with the PCB. If the solder is not flowing around the board you may need a higher wattage iron (generally 25W to 30W is enough).

Initial Startup of Circuit

It is best to initially power up the board by setting the input supply voltage to the lowest operating input voltage 12.0V and set the input supply's current limit to zero. With the input supply off connect up the input supply to Vin and GND. Connect a digital volt meter and a load if needed to set the minimum Iout of the design from Vout and GND. Turn on the input supply and slowly turn up the current limit on the input supply. If the voltage starts to rise on the input supply continue increasing the input supply current limit while watching the output voltage. If the current increases on the input supply, but the voltage remains near zero, then there may be a short or a component misplaced on the board. Power down the board and visually inspect for solder bridges and recheck the diode and capacitor polarities. Once the power supply circuit is operational then more extensive testing may include full load testing, transient load and line tests to compare with simulation results.

Load Testing

The setup is the same as the initial startup, except that an additional digital voltmeter is connected between Vin and GND, a load is connected between Vout and GND and a current meter is connected in series between Vout and the load. The load must be able to handle at least rated output power + 50% (7.5 watts for this design). Ideally the load is supplied in the form of a variable load test unit. It can also be done in the form of suitably large power resistors. When using an oscilloscope to measure waveforms on the prototype board, the ground leads of the oscilloscope probes should be as short as possible and the area of the loop formed by the ground lead should be kept to a minimum. This will help reduce ground lead inductance and eliminate EMI noise that is not actually present in the circuit.



Design Assistance

1. Part Description The LM22676 is a monolithic integrated circuit that provides all of the active functions for a step-down (buck) switching regulator capable of driving up to 3.0A loads with excellent line and load regulation characteristics. High efficiency (>90%) is obtained through the use of a low ON-resistance N-channel MOSFET.

2. Master key : A353B67D62C1BA9A[v1]

3. **LM22676** Product Folder : http://www.ti.com/product/LM22676 : contains the data sheet and other resources.

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